Distribution and Status of the Southwestern Willow Flycatcher along the Colorado River in the Grand Canyon - 1994

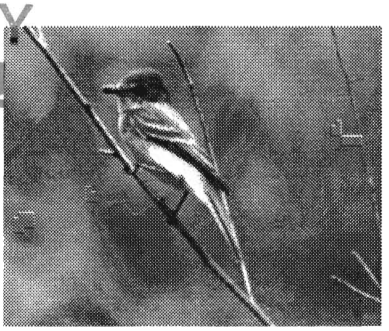

Photo by G. Andrejko, AGFD

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- 1994 -

Photograph courtesy of Audubon Society Encyclopedia of North American Birds

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SUMMARY

We conducted surveys for the southwestern willow flycatcher (*Empidonax traillii extimus*) in riparian habitats along the Colorado River corridor from Glen Canyon Dam to Lake Mead (River Mile (RM) 277), and in the lower sections of selected tributaries. We surveyed for flycatchers by moving through or adjacent to riparian habitat patches, broadcasting flycatcher songs from hand-held tape players, and listening and looking for willow flycatchers. We detected 26 willow flycatchers - 17 migrants, one territorial but non-breeding male, and four breeding pairs. The migrants were found primarily from RM -8 to RM 71; the non-breeding male established a territory at RM 65.3 L; and the breeding pairs were at RM 50.5 L and RM 51.4 L. Brown-headed cowbirds (*Molothrus ater*) parasitized at least four of the nine active flycatcher nests that we found. Cowbird parasitism, combined with other unknown destructive factors, caused total nest failure with the result that no willow flycatcher young were produced in 1994. The number of southwestern willow flycatchers along the Colorado River corridor in Grand Canyon National Park and Glen Canyon National Recreation Area remains very low. With continued cowbird-induced breeding failure, the population may be lost. We recommend future flycatcher monitoring, recreation closures at known or potential flycatcher breeding sites during the breeding season, and establishment of a cowbird monitoring and control program at Grand Canyon National Park pack animal corrals and mule stations.

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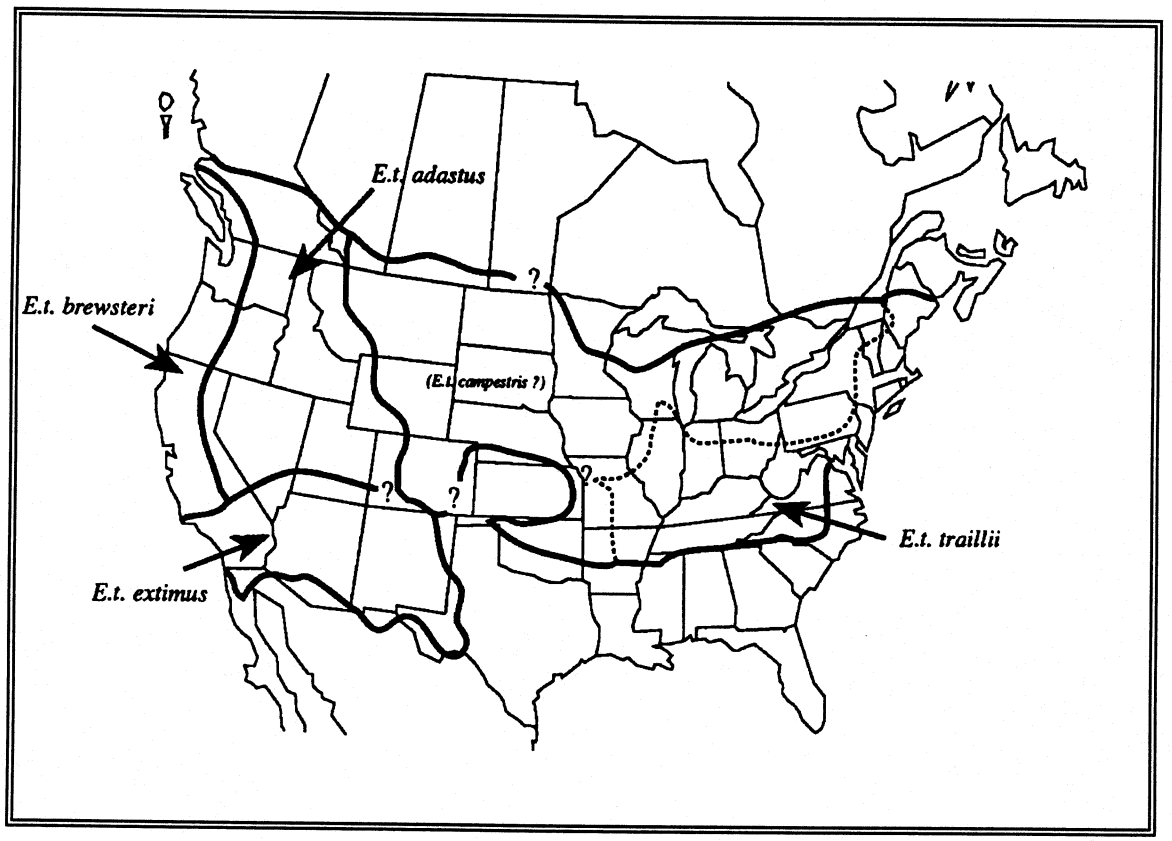
ACKNOWLEDGMENTS

This project would not have been possible without the cooperation of many persons and many agencies. Logistical support was provided by Grand Canyon National Park, Glen Canyon National Recreation Area, the National Biological Survey Colorado Plateau Research Station at Northern Arizona University (CPRS/NAU), and the U.S. Bureau of Reclamation Glen Canyon Environmental Studies (GCES) office. Particular thanks to David Wegner (GCES Program Manager); Mark Law (Grand Canyon National Park River Subdistrict Ranger); and Susan Cherry (Grand Canyon National Park Ranger). Park rangers, river boatmen and their assistants made the trip safe, enjoyable, and more productive. Assistance from Grand Canyon National Park and Glen Canyon National Recreation Area resource management staff, particularly John Ray (GRCA), Andrew Hands (GRCA), and Clive Pinnock (GLCA), was vital to the project. The flycatcher surveyors (see Appendix 2) worked incredibly hard under difficult field conditions - it was only through their excellent work that this project was a success. In particular, we would like to thank Matthew Johnson, Rob Marshall, Susan Sferra, and Brad Valentine, who took time out from very busy schedules to lend their expertise and efforts. Lawrence Abbott contributed his energy, dedication, skill, and good humor to many miles of survey. Helen Yard assisted with remote sensing measurements. We also want to express our gratitude to the Grand Canyon river guides and rafting company staff, and the many visitors who were understanding and supportive of our research and conservation efforts (including beach closures). The river guides and staff played a vital role in the conservation of this species by interpreting the story of the willow flycatcher and its plight to the park visitors boating the canyon.

INTRODUCTION

The southwestern willow flycatcher (*Empidonax traillii extimus*) is one of several recognized subspecies of the willow flycatcher (Unitt 1987, Browning 1993), a neotropical migrant that breeds across much of North America (Figure 1). A riparian obligate species, the flycatcher generally nests in cottonwood-willow associations or similar riparian communities, although in some portions of the Southwest it will nest in tamarisk. The southwestern willow flycatcher has declined throughout its range in recent decades, possibly due to a number of factors including loss and fragmentation of riparian habitat, loss of wintering habitat, invasion of riparian habitat by the exotic tamarisk (*Tamarix* spp.), brood parasitism by brown-headed cowbirds (*Molothrus ater*), and predation (Hunter *et al.* 1987, Unitt 1987, Hunter *et al.* 1988, Whitfield 1990, Harris 1991, Rosenberg *et al.* 1991; USFWS 1993).

Figure 1. Breeding ranges of willow flycatcher (*Empidonax traillii*) subspecies. Modified from Browning (1993), who supported designation of distinct *E.t. campestris* (north and west of the dotted line in *E.t. traillii* range).



The southwestern willow flycatcher is a U.S. Fish and Wildlife Service (USFWS) candidate category 1 species (USFWS 1991). The USFWS proposed to list the subspecies as endangered (USFWS 1993) with critical habitat (including portions of the Colorado River in the Grand Canyon). A final listing decision is anticipated in 1995. The states of Arizona, New Mexico, and California comprise most of the southwestern willow flycatcher's historic and current range. Each of these states lists the species as endangered (Arizona Game and Fish Department 1988, New Mexico Department of Game and Fish 1988, California Department of Fish and Game 1991).

Willow flycatchers were once distributed along most major river systems in Arizona (Phillips 1948, Unitt 1987). However, in the 10 years prior to 1993, only three areas within the state (one of which was the Grand Canyon) were known to support nesting southwestern willow flycatchers. Beginning in 1993, the Arizona Partners in Flight program (led by the Arizona Game and Fish Department) has coordinated intensive state-wide inventories for breeding southwestern willow flycatchers. In 1993, 42-56 territorial flycatchers were found, as well as 10 active nests (Muiznieks et al. 1994). During 1994, surveyors found 116 territorial males (77 verified as paired with one or more female), with breeding occurring at 60 territories (Arizona Game and Fish Department, unpublished data). Unfortunately, confirmed breeding success was very low - only 10 documented successful nests statewide.

Prior to initiation of the state-wide surveys in 1993, it appeared that the Grand Canyon was one of the last and largest willow flycatcher breeding areas in the state. This was worrisome because the Grand Canyon population was very low and appeared to be declining. In 1986, Brown (1988) found 11 males (a singing male was assumed to represent a breeding pair). Since then, the breeding population declined to only two breeding pairs in 1991 (Brown 1991), one pair in 1992 (Sogge and Tibbitts 1992), and two pair in 1993 (Sogge et. al. 1993).

Although the recent Partners in Flight surveys have shown that the Grand Canyon willow flycatcher population is of less regional importance than once thought, the population remains of local concern due to the documented decline and current low population level. In addition, the willow flycatchers breeding in the canyon are subject to very high rates of nest parasitism by brown-headed cowbirds, with subsequent reproductive failure (Sogge et al. 1993). Cowbird nest parasitism is known to be a factor in the decline of willow flycatchers throughout the southwest (Tibbitts et al. 1994), but the Grand Canyon population is particularly affected. Since 1992, only one nest has been known to successfully produce any fledgling willow flycatchers within the entire Colorado River corridor in the Grand Canyon.

The willow flycatchers in Grand Canyon are clearly of management concern. To continue monitoring the status and distribution of this flycatcher along the Colorado River corridor, Grand Canyon National Park, Glen Canyon National Recreation Area, the USFWS, the National Biological Survey, and the U.S. Bureau of Reclamation Glen Canyon Environmental Studies (GCES) office supported surveys from 1992 through 1995. The Colorado Plateau Research Station at Northern Arizona University coordinates the project, which is funded by the GCES.

The 1994 surveys were designed to meet the following three objectives:

1. Continue to monitor willow flycatcher numbers in the Grand Canyon.
2. Continue to assess impacts of cowbird nest parasitism, and the loss or modification of habitat due to fluctuating flows.
3. Continue to assess habitat use patterns, particularly nest site characteristics, including habitat patch size and vegetation parameters.

This report is based on the results of willow flycatcher surveys conducted during the 1994 breeding season. Sogge and Tibbitts (1992) and Sogge et al. (1993) detailed previous flycatcher monitoring efforts associated with this project. Grand Canyon National Park, Glen Canyon National Recreation Area, and the Glen Canyon Environmental Studies office have agreed to support additional surveys during 1995. This document is a status report rather than a final project report. Future reports, based on additional years of sampling, will include quantitative analyses based on 1992-1995 data.

METHODS

We determined willow flycatcher presence by sightings and song detections made primarily from 0530 to 1000 hrs daily, when male song rates are the greatest (Unitt 1987). We conducted a few surveys at dusk, a period when willow flycatchers may display a secondary peak of singing (Weydemeyer 1973, Unitt 1987). In order to maximize the likelihood of detecting willow flycatchers, we followed the standardized willow flycatcher survey protocol detailed in Tibbitts et al. (1994). This technique is based on broadcasting taped willow flycatcher songs and calls in order to elicit a verbal response (singing) from any nearby territorial willow flycatcher. This technique has the advantage of allowing positive species identification of the responding bird's song by comparison to the "known" willow flycatcher tape.

Surveyors walked through, or adjacent to, surveyed habitats whenever possible. Where terrain or dense vegetation prohibited walking surveys, we made observations from boats drifting slowly past the habitat patch. After broadcasting willow flycatcher songs for 15-30 seconds (from a hand-held cassette player), surveyors listened approximately 1-3 minutes for a response. This procedure was repeated every 20-50 meters throughout each survey site.

We conducted surveys throughout the Colorado River corridor from Glen Canyon Dam downstream to Lake Mead (RM 277: river mile designations based on Stevens 1983), emphasizing the areas identified as potential willow flycatchers breeding sites: Saddle Canyon to Kwagunt Creek, and Cardenas Marsh (Brown 1988, 1991; Sogge and Tibbitts 1992, Sogge et al.1993).

We recorded all locations of singing/territorial willow flycatchers, and intensely observed flycatchers to locate nesting activity. During observation periods we recorded male singing rate (songs/minute) to provide information on daily and seasonal variation in song rates. We determined nesting status by nest inspection on each initial and subsequent survey trip, noting clutch size, number and age of young, and presence of cowbird eggs or young. We monitored nests only once each day and examined nests using a telescoping mirror to eliminate a human scent trail directly to the nest and avoid other potential disturbance.

To assess the threat of cowbird parasitism, observers recorded the presence of cowbirds at all surveyed patches, and noted cowbird behavior and any willow flycatcher response.

RESULTS

Survey Effort

We conducted 271 surveys over a period of 44 days between 11 May and 18 July 1994 (Table 1); 157 surveys were conducted from land, 81 from boat, and 33 using both methods. Most surveys were conducted between Lees Ferry and Cardenas Marsh, and almost all sites were surveyed twice during the breeding season. We surveyed 182 habitat patches during a total of 190 survey hours, most of which were prior to 1000 hrs. Appendix 1 provides a detailed summary of the location, timing, and personnel of each survey. Appendix 2 provides details on the affiliations of each surveyor.

Table 1. Summary of willow flycatcher survey trips in the Grand Canyon, 1994

Dates of Survey Trip	Area of Emphasis
11 May	Glen Canyon Dam to Lees Ferry
17 May - 27 May	Lees Ferry to Phantom Ranch
02 June - 12 June	Lees Ferry to Phantom Ranch
06 June	Glen Canyon Dam to Lees Ferry
06 June - 11 June	Diamond Creek to Lake Mead
06 June - 14 June	Phantom Ranch to Diamond Creek
17 June - 26 June	Lees Ferry to Phantom Ranch
20 June - 21 June	Glen Canyon Dam to Lees Ferry
20 June - 25 June	Diamond Creek to Lake Mead
28 June - 05 July	Lees Ferry to Phantom Ranch
18 July	River Mile 50-52, RM 65, and RM 71

Willow Flycatcher Detections

Migrants

We detected 17 migrant willow flycatchers between 11 May and 2 June 1994 (Table 2). These flycatchers were considered migrants because they were detected at a location only once, or were only detected prior to 15 June (when migrants may be passing through the area: Unitt 1987). Birds that sang in response to the tape broadcast calls were assumed to be males, although females have been known to sing on rare occasions (Seutin 1987). *Empidonax* flycatchers that looked liked willow flycatchers but did not sing or otherwise respond to the tape were considered as unverified "possible" willow flycatchers (included in the table below, but not in summary statistics). All migrants were found in tamarisk or willow/tamarisk dominated habitats, and most were not detected prior to the use of the tape-playback song (Table 2).

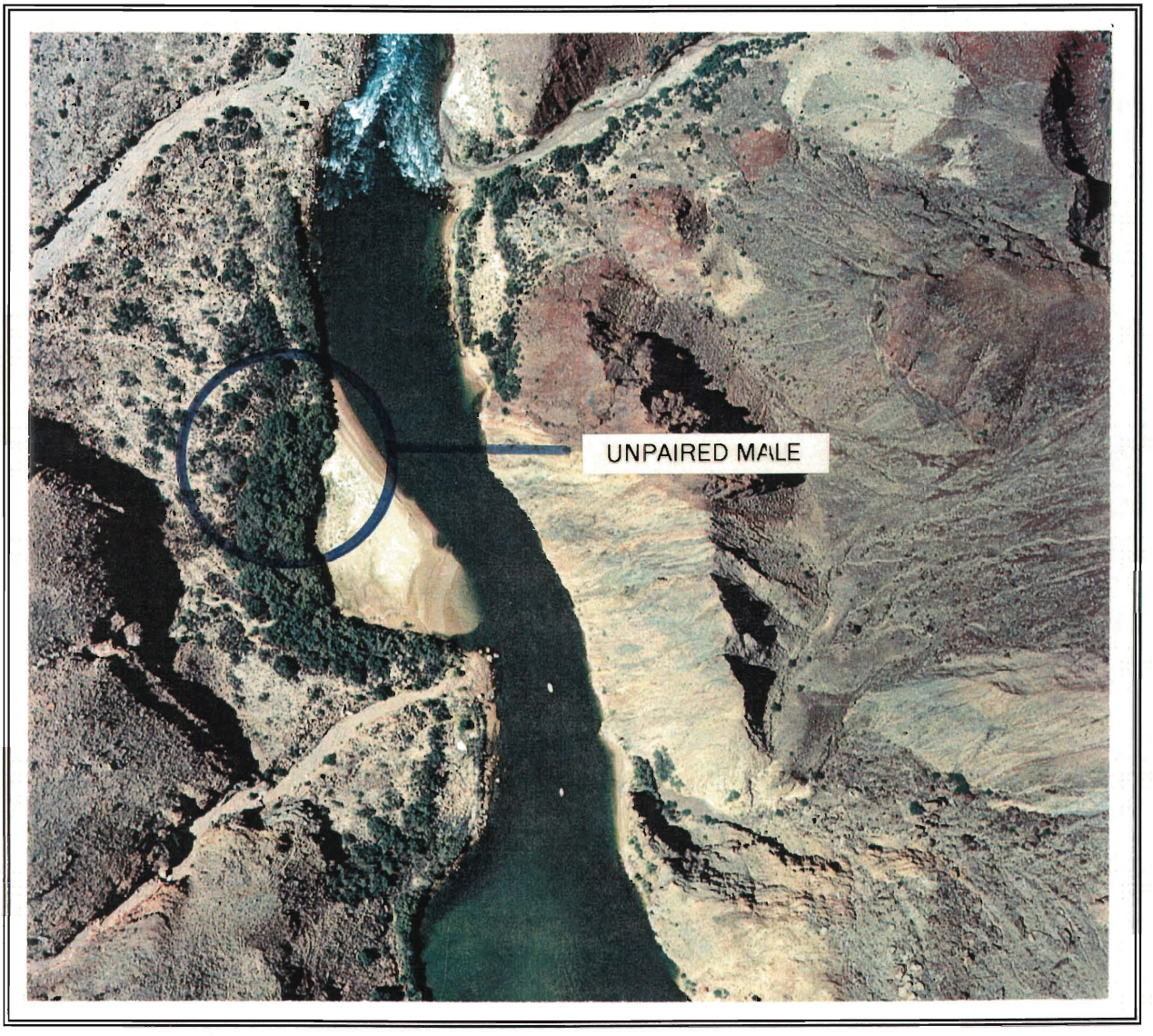
Table 2. Summary of migrant willow flycatchers detected along the Colorado River in the Grand Canyon, 1994.

LOCATION River Mile	DATE	NO. of WILLOW FLYCATCHERS DETECTED	HABITAT	DETECTED BEFORE PLAYBACK ?
-8.0 R	11 May	1 male	Tamarisk	No
0.0 R	18 May	2 males	Tamarisk	Yes
1.0 R	2 June	1 male	Tamarisk	No
2.3 L	18 May	1 male 2 possible	Tamarisk	No
2.7 L	2 June	1 possible	Tamarisk	No
5.7 R	18 May	1 male 1 possible	Tamarisk	No
5.8 R	2 June	1 possible	Tamarisk	No
41.7 L	19 May	1 male	Tamarisk/Willow	Yes
44.8 L	19 May	1 male	Tamarisk	Yes
46.5 L	20 May	1 male	Tamarisk	No
46.5 R	20 May	1 male	Tamarisk	Yes
46.7 L	20 May	1 male	Tamarisk/Willow	Yes
47.0 R	20 May	1 male	Tamarisk/Willow	Yes
51.7 L	21 May	1 male	Tamarisk/Willow	No
54.6 R	22 May	1 male	Willow/Tamarisk	No
55.3 L	22 May	1 male	Willow/Tamarisk	No
71.0 L	23 May	1 male	Tamarisk/Willow	Unknown
168.0 R	25 May	1 male	Tamarisk	No

Territorial Non-breeders

One male willow flycatcher established a territory and sang throughout much of the breeding season at RM 65.3 L (near Lava Chuar: Figure 3), but did not attract a mate. We first observed this male on 6 June, and it was present and singing strongly on 7 June, 22 June, and 2 July. Despite many hours of intense observation and nest searching, we found no evidence of pairing or breeding. The male flycatcher was not observed during our final visit on 18 July.

Figure 2. Site (circled) where unpaired male willow flycatcher established territory at RM 65.3 L along the Colorado River, Arizona, 1994. River flow is from page bottom to top.



Resident Breeders

We found breeding willow flycatchers at two sites, and each site supported two breeding pairs. Details on each site and breeding territory are presented below.

Breeding Site #1:	Refer to Figures 3 and 4
Location:	RM 50.5 L
Habitat:	A relatively large patch of dense, tall tamarisk adjacent to a small backwater area and sandbar.

Territory A: Refer to Figure 4. We first observed birds at this territory on 21 May. The resident male was counter-signing in response to the resident male at Territory B (below). On 22 May, we observed the female of this territory and found a willow flycatcher nest that was under construction. During a visit on 4 June, the nest contained two flycatcher eggs and one cowbird egg. The cowbird egg was removed. On 6 and 7 June, the pair was still present, and the nest still active (although we did not check the nest contents). Upon our return on 18 June, we found that the first nest had been destroyed. A new nest was found on 19 June, but eggs had not yet been laid. The nest was checked on 29 June, and contained two flycatcher eggs and one cowbird egg (which we punctured to assure that it did not hatch). On 18 July, the nest contained only two cowbird eggs and appeared to be abandoned (there was no flycatcher activity in the area).

Territory B: Refer to Figure 4. This territory was also discovered on 21 May, when the resident male was observed singing concurrent with the male at Territory A. The following day, we found the resident female and a nest that was under construction. This nest was located approximately 25 m from the Territory A nest. The nest contained three flycatcher eggs and one cowbird egg on 4 June. We removed the cowbird egg. On 6 and 7 June, the pair was still present and the nest active (although we did not check the nest contents). During our 18 June survey, we found the first nest destroyed. On 19 June, we located a new nest containing one willow flycatcher egg. On 29 June, this new nest contained two willow flycatcher eggs and one cowbird egg (which we punctured). When checked on 18 July, the nest contained only two punctured cowbird eggs, and appeared to be abandoned.

On 18 July, we found a third willow flycatcher nest within the area that we considered as Territory B. This "third nest" was abandoned, and contained only one punctured willow flycatcher egg. This nest may have represented another nesting attempt by the Territory B pair. It is also possible, although less likely, that another pair of flycatchers established a territory and tried (unsuccessfully) to breed there.

Figure 3. Topographic map of willow flycatcher Breeding Sites #1 (RM 50.5 L) and #2 (RM 51.4 L), along the Colorado River, Arizona. Locations of flycatcher breeding areas are circled. Base map is USGS Nankoweap Mesa quad.

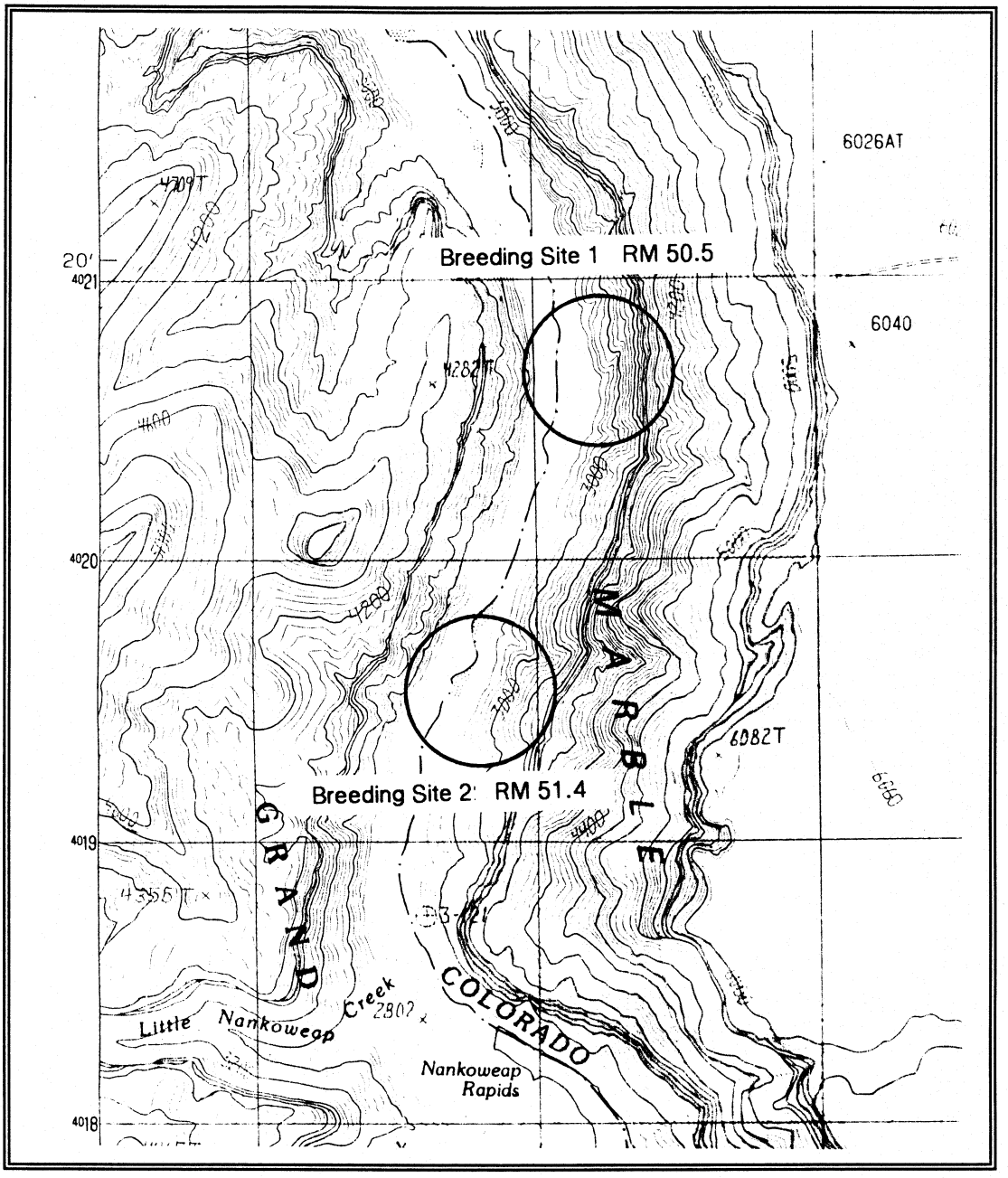
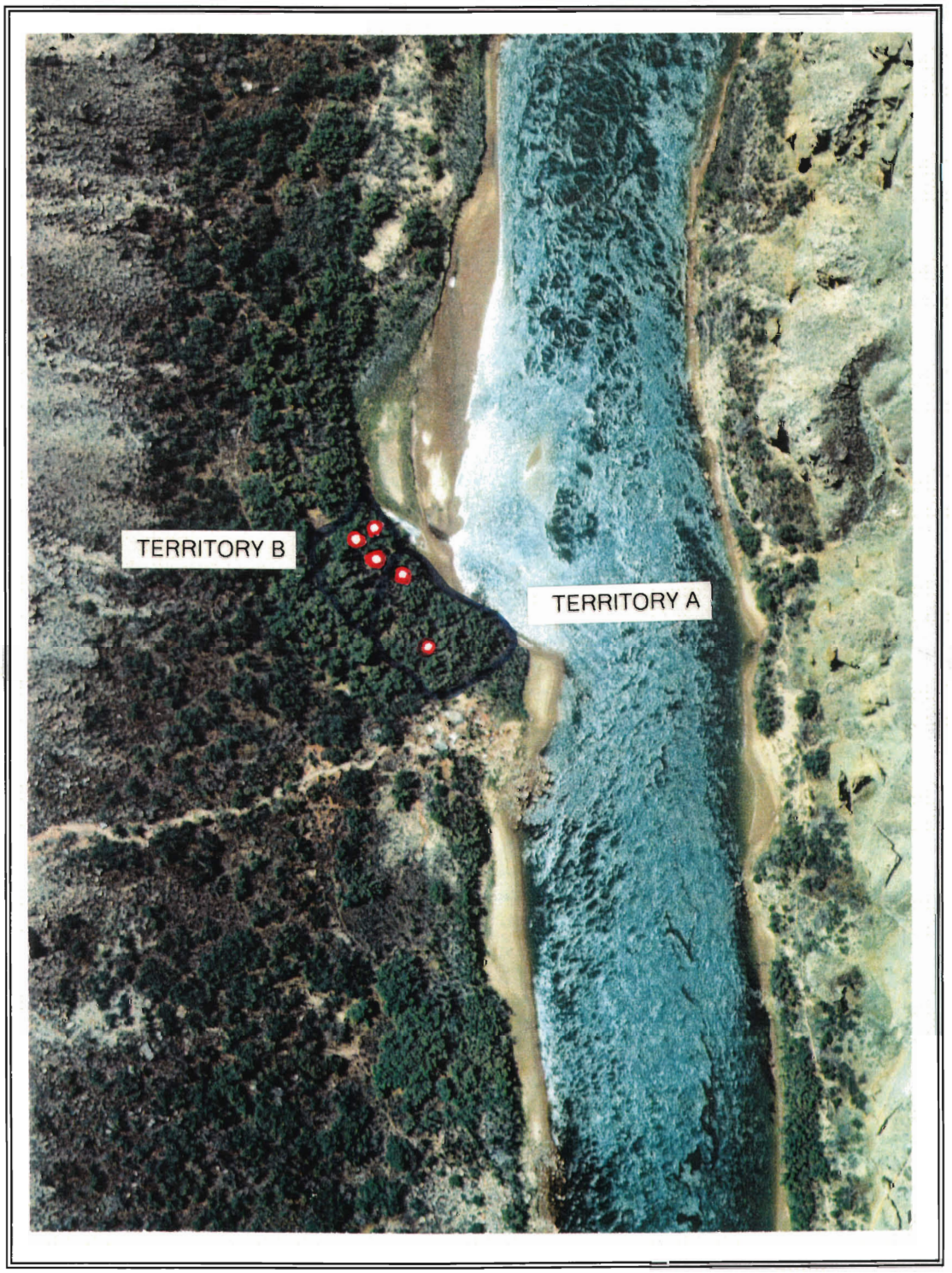


Figure 4. Aerial photograph of willow flycatcher Breeding Site #1 (River Mile 50.5 L), along the Colorado River, Arizona. Locations and approximate boundaries of flycatcher territories are indicated by blue lines; nest locations are indicated by the red/white dots. River flow is from page bottom to top.

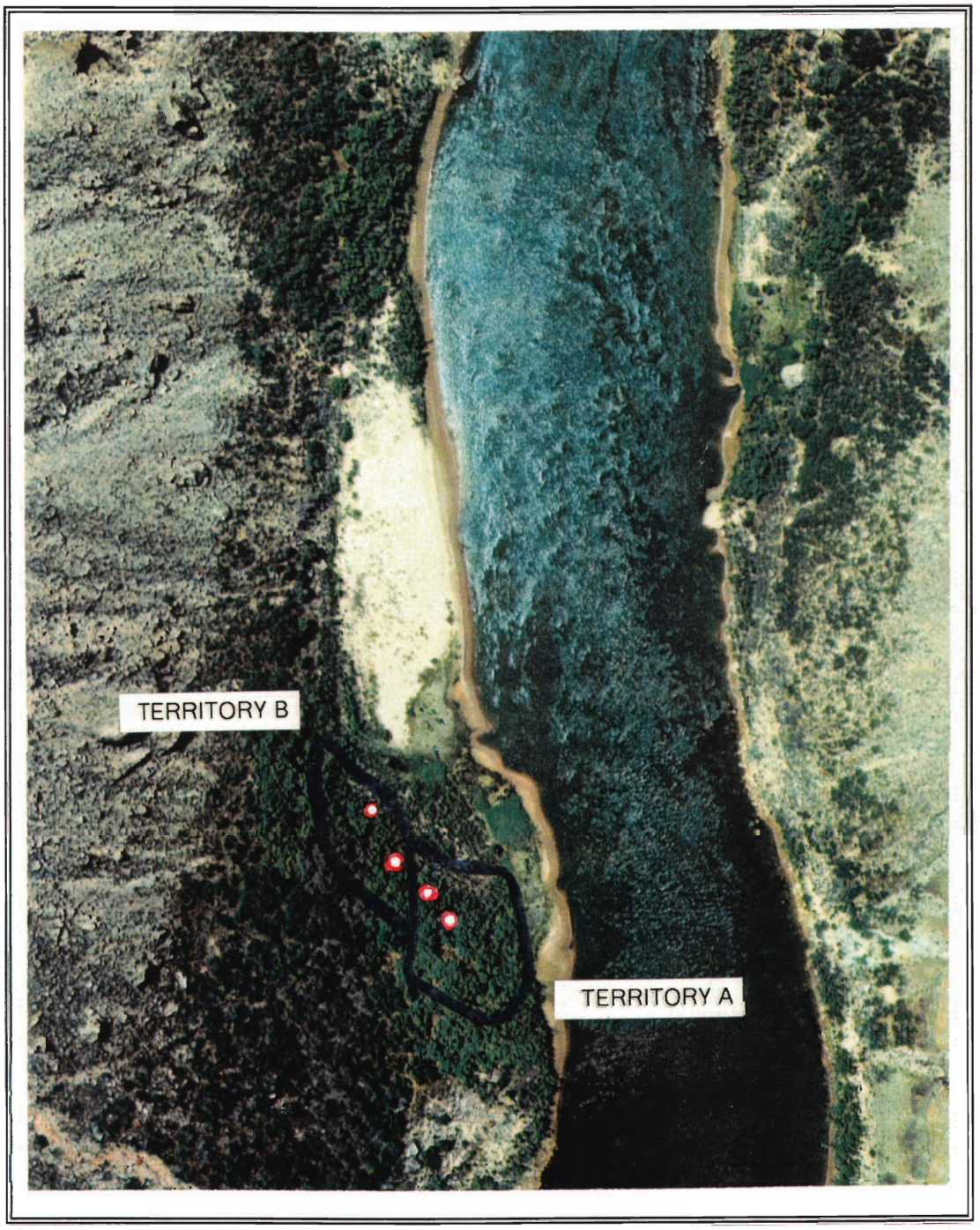


Site #2: Refer to Figure 5.
Location: RM 51.4 L
Habitat: Relatively large, dense patch of tall tamarisk patch with coyote willow (*Salix spp.*) and *Equistitim* and *Scirpus* along river's edge.

Territory A. Refer to Figure 5. We first observed a singing male on this territory on 21 May. On 5 June, we discovered the resident female and an active nest containing one willow flycatcher egg. On 7 June, the flycatcher egg was missing from the nest, but the nest structure showed no sign of disturbance. We returned on 21 June and found that the first nest had been destroyed, and a second nest built but with no eggs. On 29 June, the second nest still contained no eggs, and there was no sign of activity nearby. Our 18 July survey similarly showed no further flycatcher activity in this territory.

Territory B. Refer to Figure 5. Breeding activity was first noted here on 5 June, when we found a resident pair and a new nest that did not yet contain eggs. The following day, we noticed that the female had a red color band on her right leg, indicating that she had been captured by the Avian Monitoring research crew at RM 46.5 (Saddle Canyon/ Triple Alcoves) during June or July 1993 (see Site #3 in Sogge et al. 1994). On 7 June, we did not check the nest contents but the female was sitting on the nest (suggesting one or more eggs may have been present). During our 21 June nest, we found the first nest destroyed. However, the pair was still present and we found a second active nest (but did not check the contents). On 29 June, the nest was abandoned and we found no other breeding activity. A survey on 18 July failed to find flycatchers at this territory.

Figure 5. Aerial photograph of willow flycatcher BreedingSite #2 (River Mile 51.4 L, Colorado River, Arizona). Location and approximate boundaries of flycatcher territories are indicated by the blue lines; nest locations are indicated by the red/white dots. River flow is from page bottom to top.



Nest Location

Each of the willow flycatcher nests that we found were placed 4 - 7 m high in tamarisk. Most nests were placed in forks of branches near the bottom of the canopy, not in the higher, smaller branches that supported green foliage. As a result, these nests were relatively exposed and easy to see from below. The nest plant ranged from 5 - 9 m tall, and was always between 10 and 30 m from the closest point of the river. Nests were placed in the wider portions of the habitat patch, rather than in narrow stringers.

Habitat Patch Size

Willow flycatchers were detected only in the New High Water Zone (NHWZ): tamarisk and willow dominated riparian vegetation along the river corridor, typically 0-8 m above average water level. We never found willow flycatchers in the mesquite, acacia, hackberry, and redbud-dominated habitats higher on the slopes (often termed Old High Water Zone [OHWZ]), suggesting it has little habitat value for this species. The amount of NHWZ vegetation at flycatcher sites ranged from 0.4 to 0.6 ha (Table 3). Breeding willow flycatchers did not use the entire habitat patch in which they nested, at least during the course of our observations (Table 4).

Table 3. The area of New High Water Zone (NHWZ) vegetation in the habitat patches where willow flycatchers territories were detected, and the size each territory (as determined by observing interactions between adjacent pairs, and mapping where resident flycatchers moved within the patch) along the Colorado River, Arizona in 1994. Values given are hectares.

SITE	Patch Size (ha of NHWZ)	Territory Size (ha)
#1 RM 50.5 L	0.47	Breeding Territory A = 0.09 Breeding Territory B = 0.06
#2 RM 51.4 L	0.36	Breeding Territory A = 0.11 Breeding Territory B = 0.07
#3 RM 65.3 L	0.61	Non-breeding Territory = 0.49

Willow Flycatcher Song Patterns

Most singing male willow flycatchers vocalized using a combination of *fitz-bew* and *whitts*. At locations with known breeding pairs, all males vocalized with songs and calls. We saw no evidence of female song, although they regularly gave *whitt* calls, particularly when surveyors were in close proximity to a nest. However, since only one flycatchers was color-banded, we can not be sure all singing birds were male.

Resident, territorial males regularly sang as early as 0345 hrs, and sometimes as late as 2000 hrs. Several males sang spontaneously, prior to any tape playback. The most vociferous males were: (a) unpaired; (b) adjacent to other singing males; or (c) paired males early in the breeding season. Late in the breeding season, mated males with active nests often failed to sing, even in response to tape playback (although they usually *whitted*, see below).

Additional quantitative data on song rates will be presented in future reports pending a larger sample size of singing males and quantitative acoustical analyses.

Whitting was the most common vocalization of paired willow flycatchers. *Whitts* were heard regularly throughout the day, particularly when flycatchers or surveyors were close to the nest, or when a flycatcher tape was played at a site. *Whitts* were so common among breeding pairs that it would be difficult to spend much time in an active territory without hearing such a call.

A variety of interaction and greeting vocalizations were given by paired flycatchers, particularly in the areas around nests. These included soft, quiet *wheek*, *whinny*, and *wheak-de-dee* calls.

Brown-headed Cowbird Activity and Willow Flycatcher Response

We commonly observed brown-headed cowbirds near or within many of the habitat patches surveyed during this study, including virtually every site where breeding willow flycatchers were found. Female cowbirds were often present (accompanied by one or more courting males), and were occasionally seen moving slowly through the habitat patches, a characteristic indicative of a cowbird searching for host bird nests.

Cowbirds sometimes came within a few meters away from the resident flycatchers. On several occasions resident willow flycatchers became very alert at or near the nest, and sometimes confronted cowbirds with aggressive actions such as flying directly at the cowbird, loud *whitting*, and bill-clacking.

Cowbird eggs were found in four of the five willow flycatcher nests in which we could verify flycatcher egg laying . In some cases, nests were parasitized repeatedly. In each case, these nests suffered abandonment and reproductive failure, in terms of production of willow flycatcher young.

DISCUSSION

Survey Methodology

Our methods were successful in detecting both breeding and unpaired flycatchers. We found the territorial males at Breeding Site #1 and the first male at Breeding Site #2 before song tapes were played - *e.g.*, they were already singing when the surveyors first approached their territories. However, 10 of the 17 migrant flycatchers were not detected until after they responded to tape-playback, and may not have been detected at all if taped calls had not been used. Similarly, we first detected the non-breeding territorial male at RM 63.5 after tape-playback. Relying upon passive surveys (simply hearing spontaneously singing males) would clearly have underestimated the number of willow flycatchers in the canyon. Therefore, the Tibbitts et al. (1994) protocol should continue to be used for future surveys.

Multiple surveys at each site are also important. For example, we did not detect both territorial male flycatchers at Breeding Site #2 until the second survey. A single earlier survey would have underestimated the number of resident and breeding flycatchers. Conversely, single surveys or observations of willow flycatchers may overestimate the local population of *E.t. extimus*, because other races may be present in *extimus* range during much of its breeding season (see discussion of migration schedule *in* Unitt 1987). In our 1994 surveys, we were able to differentiate the 17 migrant flycatchers from the nine resident birds only because our later surveys verified that the migrants were no longer present. A single early-season survey would have greatly overestimated the canyon's resident flycatcher population. Thus, second or repeated surveys are important for determining breeding status and success, and should be timed to encompass the period from approximately 15 June - 15 July (Tibbitts et al. 1994).

Surveys conducted by walking through the habitat patches are also preferable, in terms of the probability of detecting non-singing willow flycatchers. Flycatchers are sometimes not detected until the surveyors are within the midst of the habitat patches. Surveys conducted from the river would probably not have elicited a response from these birds, again leading to fewer detections. Also, song rate decreases, and the frequency of calling (*whitts*) increases, after males pair with a female and as the breeding season progresses (Stafford and Valentine 1985; Sogge and Tibbitts 1992; Tibbitts et al. 1994). Surveys conducted while walking through the habitat have a much better chance of visually detecting a quiet male (or female) bird, and of hearing *whitt* calls, than do surveys conducted from the river. When on a floating raft, the sound of water sometimes causes significant background noise that interferes with aural detections. Walking surveys also allow more thorough coverage of wide habitat patches.

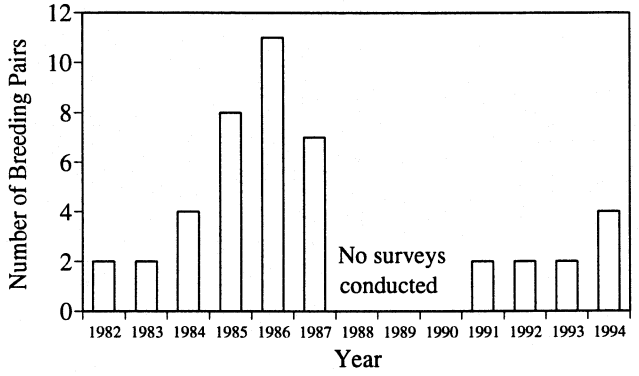
Willow Flycatcher Status - Numbers and Distribution

We detected more willow flycatchers in 1994 than have been reported in any previous survey. However, the majority of these flycatchers (17 of 26) were migrants that were detected primarily because our first surveys were conducted at a time that many willow flycatchers are migrating northward. Our surveys show that many willow flycatchers use the riparian habitats along Colorado River corridor as a migratory corridor. Thus, the status and condition of Colorado River riparian zones is important to willow flycatchers breeding within the canyon and elsewhere. Migrants used the same general types of habitats (tamarisk and willow) used by breeders, although the specific patches used by migrants were often more sparse and would be considered unsuitable for nesting. Resident flycatchers were initiating breeding activities while migrants were still passing through the canyon.

Nesting (unsuccessful) occurred at one site (RM 50.5) where we found nesting flycatchers in 1993 (Sogge et al. 1993). In addition, willow flycatchers nested at RM 51.4, an area where nesting occurred historically but has not been recorded not since 1987 (Brown 1991). This is a continued expansion of willow flycatcher breeding activity in the RM 50-52 stretch that was first noted in 1993 (Sogge et al. 1993).

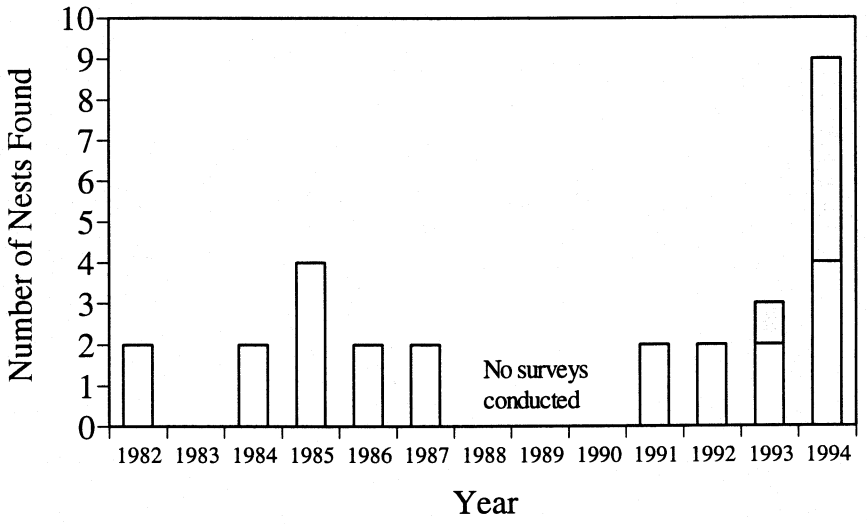
Because our 1992 through 1994 survey methods differed from those used in pre-1992 surveys (Brown 1991), we can not directly compare our data with Brown's estimates of flycatcher numbers. However, if we consider the number of breeding pairs that we found to be roughly analogous to the number of singing male flycatchers (and assumed breeding pairs) found by Brown (1991) pre-1992 (when tape playback was not used), then our 1994 total of four pairs is lower than the numbers detected in the 1980s, but greater than from 1991 to 1993 (Brown 1991, Sogge and Tibbitts 1992, Sogge et al. 1994: Figure 7).

Figure 6. The number of breeding willow flycatchers pairs detected along the Colorado River corridor in the Grand Canyon, Arizona: 1982 - 1994. Surveys from 1992 - 1994 used tape-playback; those prior to 1992 did not. Pre-1992 surveys varied in timing and degree of effort. No surveys were conducted from 1988 - 1990.



The best indicator of the flycatcher breeding status within the canyon is the actual number of active nests found and the number of successful nests. In 1994, we found evidence of nine active nests - the greatest number ever reported for flycatcher surveys in the canyon (Figure 8). Although more nests than ever found in the past, it is important to keep in mind that these nests were produced by only four nesting pairs - a precariously low number. In fact, the number of nest was high primarily because of the failure of all four first nests. The fact that all nine nests failed to produce any willow flycatcher young also points out that an increase in the number of nests does not necessarily translate into an increase in productivity.

Figure 7. The number of willow flycatchers nests detected along the Colorado River corridor in the Grand Canyon, Arizona: 1982-1994. Shaded areas represent known renesting attempts (following failed nests) within the same breeding season. Surveys prior to 1992 varied in timing and degree of survey effort. No surveys were conducted from 1988 - 1990.



Another disturbing aspect of our 1994 survey results is the lack of willow flycatcher breeding activity at Cardenas Marsh (RM 71.0 L). Cardenas has been the most consistent breeding location in the canyon, with nests found there during all surveys from 1982 - 1993. In fact, it was the only site where breeding occurred in 1991 and 1992 (Brown 1991, Sogge and Tibbitts 1992). We do not know why no willow flycatchers nested there this year. One possibility is that habitat change, particularly the recent drying of the marsh area, has made the site unsuitable. Another possibility is that human disturbance may have prevented flycatchers from establishing a territory. However, a recreation closure was in place and should have prevented excess disturbance. It may also be that the flycatchers that bred at Cardenas in previous years did not survive the winter, and were not replaced by new individuals. Although no specific cause can be determined, the loss of breeding activity at Cardenas is of concern.

The continued low resident population level makes the willow flycatchers in the Grand Canyon susceptible to extirpation by stochastic events (such as severe weather or fire), brown-headed cowbird nest parasitism (see Brown-headed Cowbird Impact section below), or natural attrition. In fact, the canyon population may not be self-sustaining, but rather composed (partially or primarily) of willow flycatchers produced elsewhere that disperse to set up breeding territories in the canyon. This hypothesis is supported by the increase in breeding pairs between 1993 and 1994, even though no willow flycatcher young were produced in the canyon during 1993 (Sogge et al. 1993). Long-term studies of color-banded adults and nestlings could help determine if resident breeding birds, and birds fledged in the canyon, return in subsequent years.

Willow Flycatcher Breeding Biology

Willow flycatcher breeding habitat and nest locations in the Grand Canyon were similar to those characterized by Brown (1988, 1991), Sogge and Tibbitts (1992), and Sogge et al. (1993). Nesting biology and nest sites were also similar to patterns observed for willow flycatchers breeding at lower elevations in other parts of Arizona (Muiznieks et al. 1994; Arizona Game and Fish unpublished data). The dates of territory occupancy and incubation of eggs (late May and early June) are slightly earlier than the range previously noted by Brown (1988) and Sogge and Tibbitts (1992). However, they are within the range expected given the results of the previous year (Sogge et al. 1993) and increasing years of survey effort.

We could not determine the clutch size of the flycatcher nests we found in 1994, due to nest destruction and cowbird parasitism. The average for *E.t. extimus* along the Colorado River is three eggs per clutch (Unitt 1987, Brown 1988, Sogge and Tibbitts 1992). Clutch size in other willow flycatcher populations is typically 3-4 eggs/clutch (Holcomb 1972; Sanders and Flett 1989, McCabe 1991).

Vocalization Patterns and Characteristics

The *fitz-bew* song of territorial male willow flycatchers and unpaired/migrant flycatchers responding to tape playback followed the general pattern described in Unitt (1987), and recorded from willow flycatchers in other areas. However, the willow flycatchers breeding in the canyon from 1992 through 1994 appear to have a difference in song dialect than commercially available recordings of other flycatcher races (typically Rocky Mountain or East Coast specimens). Southwestern willow flycatchers in the canyon have a distinctly longer, more protracted, and more "rolling" *fitz-bew*. Several of the surveyors during the past three years have extensive experience with willow flycatcher populations outside of the canyon and noted that the canyon birds sounded distinctly different from willow flycatchers of other races but similar to *E.t. extimus* from other parts of its range.

Thus, it may be possible to differentiate (with experience or acoustic analytical equipment) songs of *E.t. extimus* from some other races. This would be an extremely useful management tool, in that it would allow an effective, non-intrusive method of distinguishing subspecies. However, theories of distinct subspecies dialects must be quantitatively tested. To this end, we continue to record male southwestern willow flycatcher songs and calls in the Grand Canyon, and elsewhere it its range. Once a sufficient sample of males is obtained, the Borror Laboratory of Bioacoustics at Ohio State University will assist with analytical comparison of the southwestern willow flycatcher vocalizations with those of other subspecies, to determine if there are distinct dialects.

Male willow flycatcher song rates and daily/seasonal patterns were also similar to those described by Unitt (1987), Brown (1991), Sogge and Tibbitts (1992), and Sogge et al. (1994). Song rates were highest for unpaired males and paired males with a neighboring singing male. Song rate declines later in the season, and when birds are paired and have active nests. During any part of the breeding season, males with active nests may sing very infrequently and may not sing in response to a tape-broadcast call.

These song rate patterns have important implications with regard to survey methodology. In general, surveys conducted early in the breeding season will probably detect territorial males, because they are probably unpaired or without an active nest, and thus highly vocal at that time. Early-season surveys can therefore be conducted later in the morning, and perhaps in early afternoon, because territorial males will probably still be singing. However, mid- and late-season surveys should be conducted primarily in early morning, when males that are still singing will be doing so at the greatest rate. Late-season surveys also have a greater risk of not detecting resident males at all, because male song is reduced or absent at that time. Once resident flycatchers are paired and have active nests (typically, but not always, later in the season), singing may be greatly reduced or absent. However, paired male and female flycatchers with active nests *whitt* throughout the day. Therefore, surveyors should be particularly familiar with, and attentive for, willow flycatcher *whitt* and greeting calls during all times of the breeding season.

Brown-headed Cowbird Impacts

Cowbirds were present at almost every site where willow flycatchers were found, and at all sites where flycatchers bred. Indeed, cowbirds are common throughout the entire Colorado River corridor from Glen Canyon Dam downstream to Lake Mead (Johnson and Sogge 1993).

Cowbirds parasitized four of the five 1994 willow flycatcher nests in which we know the flycatchers attempted to lay eggs and raise young. The four parasitized nests represented all of the nesting attempts of the two pairs at RM 50.5. Some of the nests at RM 51.4 may also have been parasitized, but the timing of nest failures at these sites

made it impossible for us to determine cowbird effects (if any). Historically, approximately half of the flycatcher nests examined in the canyon during the 1980s were parasitized by cowbirds (Brown 1988), and all 1993 nests were parasitized (Sogge et al. 1993). Taken together, these data show that cowbird parasitism of flycatcher nests along the river corridor is a pervasive, long-term problem. Given that: (a) riparian habitat along the river corridor has remained stable or improved over the last decade (Carothers and Brown 1991); and (b) recreation closures at breeding sites probably minimize human disturbance to nesting flycatchers; then nest-parasitism by cowbirds seems to be the most imminent direct threat to the breeding population of flycatchers within the canyon. Other threats may occur outside of the breeding range and season, but such threats are not under the control of the National Park Service.

If the high rates of cowbird parasitism noted by Brown (1988), Sogge et al. (1993), and in this study continue, the resultant decrease or failure in flycatcher productivity may lead to the extirpation of the canyon willow flycatcher population. As with most small neotropical migrant songbird, the willow flycatcher is relatively short-lived (average lifespan is approximately 3-4 years) and has high juvenile mortality. Thus, if the flycatchers currently breeding in canyon produce few or no young for several breeding seasons, there will be no new flycatchers to replace the older breeders that die. This may have been the case at Cardenas Marsh. It is possible that southwestern willow flycatchers from other areas could settle in the Grand Canyon area (as discussed on page 18), given time and serendipitous dispersal.

Female cowbirds usually lay 14-16 eggs per nesting season but are capable of laying up to 77 eggs (Jackson and Roby 1992, Holford and Roby 1993). This high fecundity requires a high energy (and calcium) intake, forcing cowbirds to forage where food (seeds, grain, and insects) is concentrated. Brown-headed cowbirds typically demonstrate a daily cycle of movement between foraging areas (during mid-day) and breeding areas (at night and early morning). Radio-tracking of cowbirds in California showed that cowbirds spent mornings parasitizing nests in riparian zones and then commuted 2-7 km in the late morning and afternoon to one or more prime feeding sites such as horse corrals and pack stations (Rothstein *et al.* 1984). Without concentrated food sources such as pack stations, cowbirds would probably not be found in an area.

There are mule and horse corrals at several sites in the Grand Canyon, and Johnson and Sogge (1993) clearly demonstrated that cowbirds are concentrating at several corrals (and other areas such as the Desert View parking lot) along the South Rim, where they feed in late morning and afternoon. These concentrated food sources are close enough (4-6 km) to the river corridor, that cowbirds could easily be moving between the two areas (S. Rothstein, pers. comm.). In addition, livestock grazing (which attracts cowbirds) is common on Forest Service, Bureau of Land Management, and tribal lands along the North and South Rims. Also, cowbirds associate and forage with the buffalo herds at House Rock State Buffalo Ranch (Sogge, unpublished data), which is only 7.5 km from the RM

50.5 site. Thus, many human-related activities attract cowbirds to within close proximity of current (and potential) flycatcher breeding habitat.

There are other factors contributing to reduced flycatcher nesting success in the canyon. This year, several nests were destroyed, by factors unknown, before successful breeding could occur. A variety of causes, including weather and predation, could be involved but can not be determined without more intensive study at each site.

Effects of Interim Flows

Interim flows guidelines for the operation of Glen Canyon Dam dictate minimum and maximum flow releases of approximately 8,000 and 20,000 cfs, respectively, and restrict the ramping rate (the rate of flow change). Interim flows could potentially directly impact willow flycatchers by drowning nests and/or destroying nest substrate (e.g., the nest tree or bush). We observed neither of these effects. Due to the height (at least 3.5 m above ground level) of the flycatcher nests found in this study, it is unlikely that interim flow water levels could cause nest inundation, even at 20,000 cfs. The tamarisk patches in which the flycatcher nests were located are rooted at least 1 m above the level of high flows observed during this study. Thus, interim flow water levels would not likely cause direct damage or destruction of the nest substrate.

Daily water fluctuations could potentially erode the river banks and patch substrate, causing vegetation loss. We have not observed any such effects at willow flycatcher breeding sites during the last two years, but long-term erosional effects should be considered and could be modeled with data from on-going Glen Canyon Environmental Studies beach erosion research program.

The most likely flow-related impacts to the willow flycatchers would result from long-term habitat changes along the Colorado River corridor. Such indirect impacts could include habitat expansion or fragmentation, changes in plant species composition, and changes in patch size or configuration. Each of these has potential effects on willow flycatcher breeding ecology, but prediction of effects is difficult. Flow-related vegetation changes would occur over a long period of time and are not within the scope of this study, but may be addressed by the Glen Canyon Environmental Studies vegetation research and monitoring efforts currently underway. Determination of indirect impacts of interim flows is also complicated by the fact that the willow flycatcher appears to be declining on a regional level, and as a neotropical migrant, locally breeding flycatchers are subject to many environmental factors outside of the river corridor. It may be virtually impossible to separate external factors from flow-related/habitat change effects.

MANAGEMENT CONSIDERATIONS AND RECOMMENDATIONS

Continued Monitoring

The U.S. Fish and Wildlife Service published a proposed rule to list the southwestern willow flycatcher as an endangered species (USFWS 1993), and a final listing decision is expected by the spring of 1995. This potential of listing as an endangered species, coupled with the small size and apparent widespread decline of the subspecies, demonstrate the need for continued monitoring along the Colorado River corridor. Such monitoring will provide valuable information needed to continue tracking population trends, and to further define habitat use, potential threats, and management options.

We recommend continued willow flycatcher surveys in 1995. Surveys should be coordinated by the National Biological Survey Colorado Plateau Research Station (formerly the Cooperative Park Studies Unit at Northern Arizona University), and utilize the same methodology as the 1992 through 1994 surveys. The U.S. Bureau of Reclamation has provided funding that assures continuation of surveys through 1995. The U.S. Fish and Wildlife Service and Arizona Game and Fish Department have indicated that staff time to assist with surveys and coordination are expected to be available again in 1995.

Human-related Impacts

Willow flycatchers may be affected by human-related activities within the river corridor. Recreation use of the canyon has the potential of impacting the flycatchers by degrading riparian habitat. However, current recreation management practices in Grand Canyon National Park and Glen Canyon National Recreation Area are designed to minimize degradation of the riparian community. Therefore, it is unlikely that habitat alteration associated with recreation is a significant threat to willow flycatchers. However, data from future vegetation and recreation monitoring programs should be used to regularly re-evaluate this potential threat.

The repeated passage of oar and motor boats near breeding territories could cause disturbance to willow flycatchers. From 1992 to 1994, we observed no changes in behavior when boats floated or motored past the patches where birds were breeding. Additional data collected during future surveys may provide quantitative evaluation of such effects, but at this time no evidence suggests any negative effect by passing boats.

Willow flycatchers may also be disturbed by noise and activity associated with nearby campers. Taylor (1986) found a possible correlation between recreational activities and decreased riparian bird abundance. Blakesley and Reese (1988) reported the willow flycatcher (probably *E. t. adastus*) as one of seven species negatively associated with campgrounds in riparian areas in northern Utah. There is significant potential of such disturbance because flycatcher breeding areas are usually associated with sandy beach areas, which are often popular camping sites (although all breeding sites were closed to recreation in 1993 and 1994: see below). The fact that willow flycatchers have regularly bred within approximately 100 m of camping areas such as Cardenas suggests that they are generally tolerant of low-level human activity that is not directly adjacent to or within the breeding territory . However, repeated human presence within a territory or in close proximity to a nest could cause birds to abandon a territory or nest, or lead to nest failure due to reduced nest attendance.

Other human-related impacts are possible. For example, grazing has been shown to reduce the quality of riparian flycatcher habitat (Taylor 1986, Sanders and Flett 1989). Although grazing does not occur at any of the sites where willow flycatchers were found in this or previous studies, grazing does occur on some non-National Park Service lands along the river corridor and major tributaries (Kanab Creek, Paria River, Havasu Creek, etc.), and could be negatively affecting the regional flycatcher population by reducing potential habitat.

Restricted Use and Closures of Nesting Habitat

The 1994 recreation closures instituted at RM 50 - 52 and Cardenas appear to have precluded human-related impacts to the nesting willow flycatchers, at least at Breeding Sites 1 and 2. Despite the closure at Cardenas, we regularly see signs of recreation and human use there. Because there is continued potential for human disturbance if such closures are lifted, and in order to encourage the recolonization of the Cardenas site, Grand Canyon National Park should continue to eliminate possible disturbance during the breeding season. We recommend the following actions:

(1) keep the river recreation community and park visitors informed of the status and importance of the willow flycatchers along the Colorado River. Enlist their support of, and adherence to, measures taken to protect flycatchers from recreational disturbance.

(2) close the following areas to all non-research uses beginning 05 May. The closures should last at least 75 days. The exact date of ending the closures should be determined based on the known or suspected breeding activity of resident flycatchers, as determined by the breeding surveys.

Sites: RM 50 - 52 L
RM 71 L (Cardenas)

(3) immediately close any new area(s) where potentially- breeding willow flycatchers are found. The closure should last at least 75 days, or until a follow-up visit fails to find flycatchers present.

(4) research other than the willow flycatcher monitoring program should be discouraged at these sites during the closure periods. If possible, potential research should be discussed with the flycatcher program coordinator(s), to determine if it could negatively impact the flycatcher or the monitoring effort. All researchers (and field crew) conducting work at closure sites should be briefed on how to avoid disturbance to the flycatchers: avoid camping within 100 m of a nest site; avoid prolonged, loud noises or activity near flycatcher territories; use care when moving through vegetation in order to avoid damaging nests or disturbing flycatchers; and immediately leave an area if flycatchers give alarm calls (*whitts*).

Closures should be advertised in the river guide newsletters, in park literature, and by the backcountry permit office. Closure notices should also be posted at the sites, and along trails leading to the closure areas, to discourage people from camping at or visiting the area. The latter is particularly important, in that closures were not posted in 1993 and there were several occasions when hikers violated the closure at Cardenas.

We wish to note that the river guides and the river community were very supportive of the park's flycatcher conservation actions, and played a crucial role in informing park visitors about flycatcher ecology and threats to survival.

Cowbird Control Program

The cowbird population in the canyon is significant and dispersed throughout the Colorado River riparian zone (Johnson and Sogge 1993). Control of cowbirds can have beneficial effects on the breeding success of willow flycatchers, and for many other parasitized species in the canyon as well.

Many examples of effective cowbird removal programs exist. Trapping has significantly reduced local populations of cowbirds, and increased populations of rare and endangered species such as Kirtland's warblers (*Dendroica kirtlandii*; Mayfield 1977), least Bell's vireo (*Vireo bellii pusillus*; Beezley and Rieger 1987, J. Griffith, pers. comm.), black-capped vireo (*Vireo atricapillus*) and golden-cheeked warbler (*Dendroica chrysoparia*: J. Cornelius, pers. comm.), and southwestern willow flycatchers (J. Griffith and M. Whitfield, pers. comm.). Many other bird species also show increases when local cowbird populations are reduced (Laymon 1987). Laymon (in litt.) and Whitfield (in litt.) reported that cowbird nest parasitism of southwestern willow flycatchers at the Kern River Preserve declined from 65% to 20% after only one year of cowbird trapping, and remained low the following year.

We recommend that Grand Canyon National Park institute a cowbird control program in 1995, as outlined in Johnson and Sogge (1993), involving cowbird trapping at pack stations along the South Rim, where cowbirds congregate. Grand Canyon National Park and Glen Canyon National Recreation Area should also consider setting up cowbird traps at known willow flycatcher breeding areas, particularly if researchers will be present at the sites for long periods (exceeding 4 days). Trapping along the corridor would entail significant logistical planning, preparation, and trap operation, but could significantly decrease cowbird impacts at the sites.

Additional Cowbird Monitoring

We strongly support the recommendations made by Johnson and Sogge (1993) regarding continued and expanded cowbird monitoring in the Grand Canyon. In summary, these recommendations are: (1) continue monitoring cowbird abundance at Grand Canyon pack stations; and (2) use radio-telemetry to determine movement patterns of pack station cowbirds, to see if these cowbirds are dispersing to the river corridor. Recommendation 2 is of particular importance, in that it will provide information as to the effectiveness of "rim-based" cowbird control as a means to reduce cowbird nest parasitism along the river corridor and tributaries with riparian habitats.

We further recommend that agencies and tribes that manage lands adjacent to the Grand Canyon institute similar cowbird monitoring and control efforts. This is particularly true where livestock grazing, horse and mule corrals, or buffalo ranch activities occur. It is important to determine if these activities are attracting cowbirds, and providing food and other conditions that support a local breeding population. If so, cowbird control could reduce impacts to nearby breeding willow flycatchers, as well as a number of other neotropical migrant birds.

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APPENDIX 1

Summary of 1994 Southwestern Willow Flycatcher survey effort along the Colorado River corridor in Glen Canyon National Recreation Area and Grand Canyon National Park, Arizona. Patch refers to the location of each vegetation patch surveyed (by River Mile and river left/right). If the entire extent of a patch was surveyed, only one number is given (usually near the center of the patch). If only a portion of a large patch or vegetation strip was surveyed, the beginning and ending points are indicated. Method refers to whether surveys were conducted from land, boat, or both. A tape-broadcast Willow Flycatcher song was used to elicite response during all surveys. Flycatcher survey personnel for each patch are listed under Observers.

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
-14.0	6/6/94	0550	0615	Land	Elena Deshler, John Graham
(-13.6)-(-13.65) L	6/21/94	0600	0615	Land	Elena Deshler
-13.0 R	6/21/94	0620	0630	Land	Elena Deshler
-12.0	6/6/94	0620	0630	Land	Elena Deshler
(-11.1)-(-11.15) L	6/21/94	0640	0650	Land	Elena Deshler
-10.75	6/6/94	0640	0700	Land	Elena Deshler
(-10.0)-(-10.2) L	6/21/94	0700	0715	Land	Elena Deshler
(-9.3)-(-9.35) L	6/20/94	0935	0955	Land	Elena Deshler, John Graham
-9.0	6/6/94	0705	0730	Land	Elena Deshler, John Graham
(-8.0)-(-8.1) R	6/21/94	0737	0803	Land	Elena Deshler
-8.0	6/6/94	0740	0800	Land	Elena Deshler
-7.5	6/6/94	0810	0830	Land	Elena Deshler
-7.2 L	6/21/94	0813	0825	Land	Elena Deshler
(-7.0)-(-7.1) L	6/21/94	0840	0847	Land	Elena Deshler
-6.5	6/6/94	0840	0910	Land	Elena Deshler, John Graham
(-6.3)-(-6.4) R	6/20/94	0904	0922	Land	Elena Deshler, John Graham
-6.0 R	5/11/94	0710	0716	Land	Mark Sogge, Cline Pinnock
(-6.0)-(-6.5) R	6/20/94	0855	0859	Land	Elena Deshler, John Graham
(-3.5)-(-3.7) R	6/20/94	0827	0837	Land	Elena Deshler, John Graham
-3.5	6/6/94		1030	Land	Elena Deshler, John Graham
(-3.05)-(-3.5) R	6/20/94	0702	0820	Land	Elena Deshler, John Graham
(-2.7)-(-2.8) L	6/20/94	0742	0755	Land	Elena Deshler, John Graham
(-2.3)-(-2.5) L	6/20/94	0720	0736	Land	Elena Deshler, John Graham
-0.8 R	6/20/94	0635	0641	Land	Elena Deshler, John Graham
(-0.1)-(-0.2) L	6/20/94	0650	0712	Land	Elena Deshler

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
-0.1 R	5/18/94	1030	1100	Land	Randy Bangert, Brad Valentine
0 R	6/2/94	0930	0950	Land	Brenda Zimple, Randy Bangert
0 R	6/17/94	0958	1016	Land	Randy Bangert
1.0 R	5/2/94	1215	1305	Land	Randy Bangert, Brenda Zimple
1.0 R	6/17/94	1053	1115	Land	Randy Bangert
2.1 L	6/2/94	1200	1300	Land	Tim Tibbits, Lawrence Abbott
2.2-2.3 L	6/17/94	1145	1205	Land	Susan Sferra, Lawrence Abbott
2.3 L	5/18/94	1145	1310	Land	Brad Valentine, Randy Bangert
3.2 L	5/18/94	1330	1345	Land	Brad Valentine
5.6 R	5/18/94	1447	1456	Land	Randy Bangert
5.7 R	5/18/94	1500	1600	Land	Brad Valentine
5.7 R	6/2/94	1500	1600	Land	Tim Tibbits
5.8 R	6/2/94	1500	1540	Land	Lawrence Abbott
6.0	6/6/94	1145	1155	Land	Laura Ellison, Rob Marshall
6.0 R	6/17/94	1138	1148	Land	Lawrence Abbott, Susan Sferra
8.0 R	5/11/94	1001	1030	Land	Mark Sogge, Cline Pinnock, John Graham
9.0	5/11/94	1040	1100	Land	Mark Sogge, Cline Pinnock, John Graham
38.0 L	5/19/94	0800	0823	Land	Randy Bangert
38.8 R	5/19/94	0810	0827	Land	Brad Valentine
40.8-40.9 L	6/3/94	1005	1050	Land	Lawrence Abbott
41.0 R	5/19/94	0901	1005	Land	Brad Valentine, Randy Bangert
41.0-41.5 R	6/3/94	1010	1120	Land	Tim Tibbits
41.3 R	5/19/94	1015	1057	Land	Randy Bangert
41.4-42.0 L	6/3/94	1145	1230	Land	Lawrence Abbott
41.5 R	5/19/94	1020	1036	Land	Brad Valentine
41.7 L	5/19/94	1120	1310	Land	Randy Bangert, Brad Valentine
41.7-41.8 L	5/19/94	1049	1105	Land	Brad Valentine
42.0-43.1 L	6/3/94	1145	1250	Land	Tim Tibbits
42.9 R	5/19/94	1400	1420	Land	Brad Valentine
43.0-43.1	5/19/94	1436	1510	Both	Brad Valentine
43.25 L	6/3/94	1240	1250	Land	Lawrence Abbott
43.3 L	5/19/94	1350	1420	Land	Randy Bangert, Brad Valentine

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
43.4 L	5/19/94	1525	1550	Land	Brad Valentine, Randy Bangert
44.6 L	5/19/94	1559	1605	Land	Randy Bangert, Brad Valentine
44.8 L	5/19/94	1620	1656	Land	Brad Valentine, Randy Bangert
44.85 L	5/19/94	1720	1725	Land	Brad Valentine, Randy Bangert
44.9 L	5/19/94	1730	1735	Land	Brad Valentine, Randy Bangert
45.0-45.8 R	6/4/94	0715	0750	Land	Lawrence Abbott
45.1-45.8 R	5/20/94	0600	0715	Boat	Brad Valentine
45.3 L	5/20/94	0600	0725	Land	Randy Bangert
45.5-46.5 L	6/4/94	0520	0655	Land	Tim Tibbits
45.8-46.1 R	6/4/94	0710	0800	Land	Tim Tibbits
45.8-46.6 L	6/18/94	0730	0930	Land	Lawrence Abbott
45.9 L	5/20/94	0730	0800	Land	Randy Bangert
45.9-46.3 R	5/20/94	0800	0836	Both	Brad Valentine
46.0-46.6 L	5/20/94	0808	0950	Both	Randy Bangert
46.0-46.5 R	6/18/94	0735	0845	Land	Susan Sferra
46.3-46.6 R	6/4/94	0520	0630	Land	Lawrence Abbott
46.5-46.7 R	5/20/94	0845	1030	Land	Brad Valentine
46.7 R	5/20/94	1145	1225	Land	Randy Bangert, Brad Valentine
46.7 R	6/7/94	0500	0615	Land	Laura Ellison
46.7 R	6/18/94	0449	0545	Land	Lawrence Abbott
46.7 R	6/18/94	0503	0648	Land	Susan Sferra
47.0 R	6/4/94	1005	1040	Land	Tim Tibbits
47.2 R	5/20/94	1730	1735	Boat	Brad Valentine, Randy Bangert
49.2 L	5/20/94	1745	1755	Boat	Brad Valentine, Randy Bangert
50.0-50.5 L	6/5/94	0505	0750	Land	Lawrence Abbott
50.3 L	5/21/94	0630	0900	Land	Randy Bangert
50.5 L	5/21/94	0630	1100	Land	Brad Valentine
50.5 L	5/21/94	1005	1030	Land	Randy Bangert
50.5-51.4 L	6/5/94	0510	1000	Land	Tim Tibbits
50.6-50.8 L	5/21/94	1140	1155	Boat	Brad Valentine, Randy Bangert
50.5-51.0 L	6/20/94	0605	0640	Land	Susan Sferra
51.0-51.4 L	6/20/94	0720	0800	Land	Susan Sferra

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
51.1 L	5/21/94	1207	1330	Land	Randy Bangert
51.3-51.7 L	5/21/94	1220	1400	Land	Brad Valentine
51.4-51.8 L	6/6/94	0620	0715	Land	Lawrence Abbott
52.8 R	5/18/94	1404	1435	Land	Brad Valentine
53.0-53.1 R	5/22/94	1400	1420	Land	Randy Bangert
54.4-54.6 R	5/18/94	1450	1543	Land	Brad Valentine
54.7 R	6/6/94	1215	1300	Land	Tim Tibbits, Lawrence Abbott
55.1-55.4 L	5/22/94	1555	1626	Land	Brad Valentine
65.4 L	6/6/94	1720	1735	Land	Lawrence Abbott, Tim Tibbits
68.0 R	7/7/94	1330	1410	Land	Lawrence Abbott, Tim Tibbits
70.3-71.0 L	6/23/94	0620	0845	Land	Lawrence Abbott
70.7-70.9	5/23/94	1330	1615	Land	Randy Bangert
70.8-71.0 L	6/8/94	0750	0840	Land	Lawrence Abbott, Tim Tibbits, Laura Ellison, Rob Marshall
71.0 L	5/23/94	0550	0900	Land	Brad Valentine
71.0 L	5/24/94	0600	0745	Land	Brad Valentine
71.0 L	6/8/94	0505	0645	Land	Lawrence Abbott, Tim Tibbits, Laura Ellison, Rob Marshall
71.0 L	6/8/94	1800	1840	Land	Lawrence Abbott, Tim Tibbits
71.0 L	6/9/94	0530	0622	Land	Lawrence Abbott, Tim Tibbits
71.0 L	6/22/94	1800	1855	Land	Susan Sferra, Lawrence Abbott
71.0 L	6/23/94	0530	0635	Land	Susan Sferra
71.2 L	5/23/94	0545	1221	Land	Randy Bangert
108.6 R	6/9/94	0520	0720	Land	Laura Ellison, Rob Marshall
133.8 R	6/10/94	0545	0845	Land	Laura Ellison, Rob Marshall
136.2 R	6/10/94	1635	1742	Land	Laura Ellison, Rob Marshall
136.2 R	6/11/94	0545	0930	Land	Laura Ellison, Rob Marshall
143.5 R	5/25/94	0750	0800	Land	Brad Valentine
167.8 L	5/25/94	1139	1220	Land	Brad Valentine
168.0 R	5/25/94	1042	1129	Land	Brad Valentine
168.0 R	6/11/94	0400	0800	Land	Tim Tibbits
168.0 R	6/11/94	1406	1440	Land	Laura Ellison, Rob Marshall
168.8 R	5/25/94	1237	1318	Land	Brad Valentine

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
169.3 R	5/25/94	1230	1315	Land	Randy Bangert
169.5 R	6/11/94	1450	1505	Boat	Laura Ellison, Rob Marshall
169.8 L	6/11/94	1515	1523	Boat	Laura Ellison, Rob Marshall
169.9 L	6/11/94	1523	1525	Boat	Laura Ellison, Rob Marshall
170.0 L	6/11/94	1525	1545	Boat	Laura Ellison, Rob Marshall
170.3 L	5/25/94	1330	1600	Land	Randy Bangert
170.5	5/25/94	1333	1355	Land	Brad Valentine
171.0 R	6/11/94	1545	1550	Land	Laura Ellison, Rob Marshall
171.5 R	6/11/94	1551	1610	Land	Laura Ellison, Rob Marshall
186.8 L	5/25/94	1608	1614	Boat	Brad Valentine
191.1 R	5/25/94	1648	1728	Land	Brad Valentine, Randy Bangert
191.1 R	6/12/94	0545	0615	Land	Laura Ellison, Rob Marshall
192.0	6/12/94	0634	0700	Land	Laura Ellison, Rob Marshall
192.5 L	6/12/94	0711	0734	Land	Laura Ellison, Rob Marshall
194.0 L	6/12/94	0750	0815	Boat	Laura Ellison, Rob Marshall
195.0 R	6/12/94	0820	0830	Boat	Laura Ellison, Rob Marshall
195.2	6/12/94	0840	0855	Boat	Laura Ellison, Rob Marshall
197.0-198 L	6/12/94	1648	1814	Land	Laura Ellison
197.5-198.3 R	6/25/94	0530	0950	Land	Susan Sferra
197.5-198.3 L	6/25/94	0540	0900	Land	Lawrence Abbott
197.8 L	5/26/94	0921	0934	Land	Brad Valentine
198.0 R	5/26/94	0837	1041	Land	Brad Valentine
198.05 R	5/26/94	0600	0700	Land	Randy Bangert
198.1 R	5/26/94	0601	0710	Land	Brad Valentine
198.4 L	5/26/94	1135	1139	Boat	Brad Valentine
198.5 R	6/13/94	0515	0630	Land	Laura Ellison, Rob Marshall
202.6 R	5/26/94	1202	1211	Boat	Brad Valentine
204.3 R	5/26/94	1229	1400	Land	Brad Valentine
204.3 R	6/13/94	0850	0950	Land	Laura Ellison
204.3 R	6/25/94	1300	1400	Land	Susan Sferra, Lawrence Abbott
205.0 L	5/26/94	1421	1427	Boat	Brad Valentine
207.9 L	5/26/94	1446	1455	Boat	Brad Valentine

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
213.9 L	5/26/94	1535	1539	Boat	Brad Valentine
242.1 R	6/7/94	0830	0845	Land	Randy Bangert
242.5-242.7 R	5/24/94	0855	0910	Land	Andrew Hands
242.5 R	6/7/94	0850	0857	Land	Brenda Zimple
243.0 L	5/24/94	0900	0920	Land	Brenda Zimple
243.0 L	6/7/94	0900	0906	Boat	Brenda Zimple
243.1 L	6/29/94	0735	0749	Land	Randy Bangert, Brenda Zimple
246.0	5/24/94	0730	0820	Land	Brenda Zimple, Andrew Hands
246.0 L	6/7/94	0621	0800	Land	Randy Bangert, Brenda Zimple
246.0 L	6/21/94	0643	0720	Land	Randy Bangert, Brenda Zimple
246.5 L	6/9/94	0725	0740	Boat	Brenda Zimple
248.3 R	6/21/94	0803	0840	Land	Randy Bangert, Brenda Zimple
248.4 R	6/7/94	0900	0945	Land	Randy Bangert
249.0 L	5/24/94	1010	1020	Land	Andrew Hands, Brenda Zimple
249.5 L	5/24/94	1020	1045	Land	Brenda Zimple
249.5 R	5/24/94	1026	1045	Land	Andrew Hands
250.5 L	6/7/94	1011	1018	Boat	Brenda Zimple
250.5 R	6/7/94	1000	1015	Land	Randy Bangert
250.5 L	6/21/94	0900		Land	Randy Bangert
251.5-262.1 R	6/8/94	0600	1130	Boat	Randy Bangert
251.5 L	6/21/94	0920	0942	Land	Randy Bangert
252.0 L	6/8/94	0640	0655	Boat	Brenda Zimple
252.0 R	6/21/94	0920	0940	Both	Brenda Zimple
253.0 L	6/8/94	0700	0705	Boat	Brenda Zimple
253.5-254.0 R	6/21/94	0950	1005	Boat	Randy Bangert, Brenda Zimple
255.2 R	6/21/94	1010	1022	Both	Randy Bangert, Brenda Zimple
255.5 R	5/26/94	0558	0615	Land	Andrew Hands, Brenda Zimple
256.0 L	6/8/94	0740	0804	Boat	Brenda Zimple
256.6-256.9 L	6/21/94	1026	1037	Boat	Brenda Zimple, Randy Bangert
257.0-257.5 L	5/20/94	0618	0648	Boat	Andrew Hands, Brenda Zimple
257.0 L	6/8/94	0816	0822	Boat	Brenda Zimple
257.0 L	6/21/94	1038	1043	Boat	Brenda Zimple, Randy Bangert

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
257.0-258.0 R	6/22/94	0630	0740	Both	Randy Bangert
257.5-258.2 R	5/26/94	0652	0731	Boat	Andrew Hands, Brenda Zimple
258.0 R	5/26/94	0720	0805	Both	Andrew Hands, Brenda Zimple
258.0 L	6/8/94	0840	0900	Boat	Brenda Zimple
258.1 R	6/22/94	0741	0744	Boat	Randy Bangert
258.2-258.5 R	6/22/94	0746	0805	Both	Randy Bangert
258.5 R	6/8/94	0930		Boat	Brenda Zimple
259.0 L	6/22/94	0658	0712	Boat	Brenda Zimple
259.5 L	5/26/94	0914	0921	Boat	Andrew Hands
259.5 L	6/22/94	0717	0730	Both	Brenda Zimple
259.5 R	6/22/94	0820	0918	Both	Randy Bangert
259.8 L	6/22/94	0730	0745	Both	Brenda Zimple
260.0 R	5/26/94	0925	0929	Boat	Andrew Hands, Brenda Zimple
260.0 R	6/22/94	0928	0952	Both	Randy Bangert
260.1	5/26/94	0852	0912	Both	Andrew Hands, Brenda Zimple
260.1 R	5/26/94	0935	0942	Boat	Andrew Hands, Brenda Zimple
260.1 L	6/22/94	0750	0803	Both	Brenda Zimple
260.4-261.1 R	6/22/94	0952	1039	Both	Randy Bangert
261.0 L	5/26/94	0944	0949	Boat	Andrew Hands, Brenda Zimple
261.0 L	6/9/94	0558	0608	Boat	Brenda Zimple
262.0 L	5/26/94	1001	1013	Boat	Andrew Hands, Brenda Zimple
262.0 L	6/9/94	0612	0621	Boat	Brenda Zimple
262.2 R	5/26/94	1018	1034	Boat	Andrew Hands, Brenda Zimple
262.5-273.0 R	6/9/94	0530	1100	Boat	Randy Bangert
262.5 R	6/23/94	0625	0635	Boat	Randy Bangert
262.6 R	6/23/94	0635	0640	Boat	Randy Bangert
262.65 R	6/23/94	0645	0650	Both	Randy Bangert
262.7 R	6/23/94	0650	0702	Boat	Randy Bangert
262.75 R	6/23/94	0705	0709	Boat	Randy Bangert
262.8-263.6 R	6/23/94	0710	0750	Both	Randy Bangert
263.0 L	6/9/94	0629	0640	Boat	Brenda Zimple
263.0-263.5 L	6/22/94	0920	0945	Both	Brenda Zimple

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
263.5 L	6/22/94	1000		Both	Brenda Zimple
263.7 L	5/27/94	0530	0555	Boat	Andrew Hands, Brenda Zimple
263.8-264.6 R	6/23/94	0756	0851	Both	Randy Bangert
264.0 L	6/9/94	0708	0730	Boat	Brenda Zimple
264.3 R	5/27/94	0555	0610	Boat	Andrew Hands, Brenda Zimple
264.5-265.0 L	5/27/94	0612	0638	Both	Andrew Hands, Brenda Zimple
264.5 L	6/23/94	0645	0700	Both	Brenda Zimple
264.8 L	6/9/94	0745	0810	Land	Brenda Zimple
264.8 L	6/23/94	0705	0715	Both	Brenda Zimple
264.8-265.7 R	6/23/94	0858	0930	Boat	Randy Bangert
265.0 L	6/9/94	0815	0840	Boat	Brenda Zimple
265.0 L	6/23/94	0718	0730	Both	Brenda Zimple
265.2	5/27/94	0645	0650	Boat	Andrew Hands, Brenda Zimple
265.5 L	6/23/94	0735	0750	Boat	Brenda Zimple
265.8 R	6/23/94	0939	0958	Land	Randy Bangert
265.9-266.4 R	6/23/94	1000	1010	Boat	Randy Bangert
266.0 L	5/27/94	0658	0725	Land	Andrew Hands, Brenda Zimple
266.0 L	6/9/94	0900	0915	Boat	Brenda Zimple
266.0 L	6/23/94	0755	0809	Both	Brenda Zimple
266.3 L	6/23/94	0820	0830	Both	Brenda Zimple
266.5 R	5/27/94	0651	0658	Boat	Andrew Hands, Brenda Zimple
266.5 L	6/9/94	0925	0938	Boat	Brenda Zimple
266.6 L	6/23/94	0840	0900	Land	Brenda Zimple
267.0 L	6/23/94	0900	0920	Boat	Brenda Zimple
267.5-268.5 R	5/27/94	0726	0810	Both	Andrew Hands, Brenda Zimple
268.0 L	6/10/94	0540	0555	Boat	Brenda Zimple
268.0 L	6/23/94	0930	0940	Boat	Brenda Zimple
268.1 L	5/27/94	0817	0826	Boat	Andrew Hands, Brenda Zimple
268.1-268.7 R	6/24/94	0620	0649	Boat	Randy Bangert
268.5 L	6/10/94	0604	0630	Boat	Brenda Zimple
268.8 L	5/27/94	0830	0848	Land	Andrew Hands, Brenda Zimple
268.8 R	5/27/94	0854	0902	Land	Andrew Hands, Brenda Zimple

PATCH	DATE	TIME START	TIME STOP	METHOD	OBSERVERS
268.8	6/24/94	0655	0700	Boat	Randy Bangert
269.0 L	6/24/94	0555	0610	Land	Brenda Zimple
269.0-269.5 L	6/24/94	0640	0705	Both	Brenda Zimple
269.0 R	6/24/94	0710	0714	Boat	Randy Bangert
269.1 R	6/24/94	0718	0728	Both	Randy Bangert
269.4 L	6/24/94	0620	0635	Both	Brenda Zimple
269.5 R	5/27/94	0905	0910	Boat	Andrew Hands, Brenda Zimple
270.0 L	5/27/94	0912	0917	Boat	Andrew Hands
270.0-270.5 L	6/10/94	0652	0730	Boat	Brenda Zimple
270.0-270.6 L	6/24/94	0719	0740	Boat	Brenda Zimple
270.0 R	6/24/94	0744	0752	Boat	Randy Bangert
270.2-273.5 R	6/24/94	0800	0942	Boat	Randy Bangert
270.5-271.0 R	5/17/94	0910	0939	Boat	Andrew Hands, Brenda Zimple
271.0 L	6/10/94	0735	0750	Boat	Brenda Zimple
271.0-272.0 L	5/27/94	0940	1010	Boat	Andrew Hands, Brenda Zimple
271.0 L	6/22/94	0830	0850	Both	Brenda Zimple
272.8-274.6 L	6/10/94	0830	0912	Both	Randy Bangert
272.8 L	6/24/94	0810	0820	Boat	Brenda Zimple
273.0-276.5 R	6/10/94	0555	0830	Boat	Randy Bangert
273.2-274.0 L	6/24/94	0826	0840	Boat	Brenda Zimple
274.0 L	6/10/94	0810	0830	Boat	Brenda Zimple
274.3	6/24/94	0855	0915	Both	Brenda Zimple
277.0 R	5/28/94	1050	1114	Boat	Andrew Hands, Brenda Zimple

APPENDIX 2

1994 Colorado River Willow Flycatcher Survey Personnel.

Lawrence Abbott, National Biological Survey, Colorado Plateau Reseach Station, NAU, Flagstaff, AZ

Randy Bangert, National Biological Survey, Colorado Plateau Reseach Station, NAU, Flagstaff,AZ

Elena Deshler, National Biological Survey, Colorado Plateau Reseach Station, NAU, Flagstaff, AZ

Laura Ellison, National Biological Survey, Colorado Plateau Reseach Station, NAU, Flagstaff, AZ

John Grahame, National Biological Survey, Colorado Plateau Reseach Station, NAU, Flagstaff, AZ

Andrew Hands, Grand Canyon National Park, AZ

Matthew Johnson, National Biological Survey, Colorado Plateau Reseach Station, NAU, Flagstaff, AZ

Rob Marshall, U.S. Fish and Wildlife Service, Arizona Ecological Services State Office, Phoenix, AZ

Britta Muiznieks, U.S. Fish and Wildlife Service, Arizona Ecological Services State Office, Phoenix, AZ

Clive Pinnock, Glen Canyon National Recreation Area, AZ

Susan Sferra, Nongame & Endangered Wildlife Program, Arizona Game & Fish Depart., Phoenix, AZ

Mark Sogge, National Biological Survey Colorado Plateau Research Station, Flagstaff, AZ

Tim Tibbitts, U.S. Fish and Wildlife Service, Arizona Ecological Services State Office, Phoenix, AZ

Brad Valentine, California Dept. of Forestry, Santa Rosa, CA

Brenda Zimple, National Biological Survey, Colorado Plateau Reseach Station, NAU, Flagstaff, AZ